Apprenticeship and Industry Training

Outdoor Power Equipment Technician Apprenticeship Course Outline

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Apprenticeship and Industry Training

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Outdoor Power Equipment Technician
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Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding an employer. Employers hire apprentices, pay their wages and provide on-the-job training and work experience. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journeyperson or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution – usually a college or technical institute.

To become certified journeypersons, apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board on the recommendation of Outdoor Power Equipment Technician Provincial Apprenticeship Committee.

The graduate of the Outdoor Power Equipment Technician apprenticeship program is a certified journeyperson who will be able to:

- supervise, train and coach apprentices
- service, maintain, repair and rebuild outdoor power equipment and outdoor power equipment accessories
- communicate clearly with customers, staff, suppliers, as required
- work in accordance with the laws and regulations governing the industry
- work safely, and ensuring the safety of other workers and the general public
- perform assigned tasks in accordance with quality and production standards required by industry

Apprenticeship and Industry Training System

Industry-Driven

Alberta's apprenticeship and industry training system is an industry-driven system that ensures a highly skilled, internationally competitive workforce in more than 50 designated trades and occupations. This workforce supports the economic progress of Alberta and its competitive role in the global market. Industry (employers and employees) establishes training and certification standards and provides direction to the system through an industry committee network and the Alberta Apprenticeship and Industry Training Board. The Alberta government provides the legislative framework and administrative support for the apprenticeship and industry training system.

Alberta Apprenticeship and Industry Training Board

The Alberta Apprenticeship and Industry Training Board provides a leadership role in developing Alberta's highly skilled and trained workforce. The board's primary responsibility is to establish the standards and requirements for training and certification in programs under the Apprenticeship and Industry Training Act. The board also provides advice to the Minister of Advanced Education on the needs of Alberta's labour market for skilled and trained workers, and the designation of trades and occupations.

The thirteen-member board consists of a chair, eight members representing trades and four members representing other industries. There are equal numbers of employer and employee representatives.

Industry Committee Network

Alberta's apprenticeship and industry training system relies on a network of industry committees, including local and provincial apprenticeship committees in the designated trades, and occupational committees in the designated occupations. The network also includes other committees such as provisional committees that are established before the designation of a new trade or occupation comes into effect. All trade committees are composed of equal numbers of employer and employee representatives. The industry committee network is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the board can set up a local apprenticeship committee. The board appoints equal numbers of employee and employer representatives for terms of up to three years. The committee appoints a member as presiding officer. Local apprenticeship committees:

- monitor apprenticeship programs and the progress of apprentices in their trade, at the local level
- make recommendations to their trade's provincial apprenticeship committee (PAC) about apprenticeship and certification in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- make recommendations to the board about the appointment of members to their trade's PAC
- help settle certain kinds of disagreements between apprentices and their employers
- carry out functions assigned by their trade's PAC or the board

Provincial Apprenticeship Committees (PAC)

The board establishes a provincial apprenticeship committee for each trade. It appoints an equal number of employer and employee representatives, and, on the PAC's recommendation, a presiding officer - each for a maximum of two terms of up to three years. Most PACs have nine members but can have as many as twenty-one. Provincial apprenticeship committees:

- Make recommendations to the board about:
    - standards and requirements for training and certification in their trade
    - courses and examinations in their trade
    - apprenticeship and certification
    - designation of trades and occupations
    - regulations and orders under the Apprenticeship and Industry Training Act
- monitor the activities of local apprenticeship committees in their trade
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- consult with other committees under the Apprenticeship and Industry Training Act about apprenticeship programs, training and certification and facilitate cooperation between different trades and occupations
- consult with organizations, associations and people who have an interest in their trade and with employers and employees in their trade
- may participate in resolving certain disagreements between employers and employees
- carry out functions assigned by the board

Outdoor Power Equipment Technician PAC Members at the Time of Publication

Mr. S. Mace	Spruce Grove	Presiding Officer
Mr. S. Billo	Calgary	Employer
Mr. L. Klatt	Beaumont	Employer
Mr. N. Stotyn	Calgary	Employer
Mr. G. Wood	Devon	Employer
Mr. A. Fluet	Onoway	Employer
Mr. D. Erickson	Sherwood Park	Employee
Mr. C. Flathers	Strathmore	Employee
Mr. R. Jurick	Cherry Grove	Employee
Mr. G. Shafer	St. Albert	Employee
Mr. M. Waters	St. Albert	Employee
Mr. T. Jagielski	Nanton, AB	Employee

Alberta Government

Alberta Advanced Education works with industry, employer and employee organizations and technical training providers to:

- facilitate industry's development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and employers
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

Technical Institutes and Colleges

The technical institutes and colleges are key participants in Alberta's apprenticeship and industry training system. They work with the board, industry committees and Alberta Advanced Education to enhance access and responsiveness to industry needs through the delivery of the technical training component of apprenticeship programs. They develop lesson plans from the course outlines established by industry and provide technical training to apprentices.

Apprenticeship Safety

Safe working procedures and conditions, incident/injury prevention, and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees, apprentices and the public. Therefore, it is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviours that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

Alberta Apprenticeship and Industry Training Board Safety Policy

The Alberta Apprenticeship and Industry Training Board (board) fully supports safe learning and working environments and emphasizes the importance of safety awareness and education throughout apprenticeship training- in both on-the- job training and technical training. The board also recognizes that safety awareness and education begins on the first day of on-the-job training and thereby is the initial and ongoing responsibility of the employer and the apprentice as required under workplace health and safety training. However the board encourages that safe workplace behaviour is modeled not only during on-the-job training but also during all aspects of technical training, in particular, shop or lab instruction. Therefore the board recognizes that safety awareness and training in apprenticeship technical training reinforces, but does not replace, employer safety training that is required under workplace health and safety legislation.

The board has established a policy with respect to safety awareness and training:

> **The board promotes and supports safe workplaces, which embody a culture of safety for all apprentices, employers and employees. Employer required safety training is the responsibility of the employer and the apprentice, as required under legislation other than the *Apprenticeship and Industry Training Act.***

The board's complete document on its 'Apprenticeship Safety Training Policy' is available at www.tradesecrets.alberta.ca; access the website and conduct a search for 'safety training policy'.

Implementation of the policy includes three common safety learning outcomes and objectives for all trade course outlines. These common learning outcomes ensure that each course outline utilizes common language consistent with workplace health and safety terminology. Under the title of 'Standard Workplace Safety', this first section of each trade course outline enables the delivery of generic safety training; technical training providers will provide trade specific examples related to the content delivery of course outline safety training.

Addendum
As immediate implementation of the board's safety policy includes common safety learning outcomes and objectives for all course outlines, this trade's PAC will be inserting these safety outcomes into the main body of their course outline at a later date. In the meantime the addendum below immediately places the safety outcomes and their objectives into this course outline thereby enabling technical training providers to deliver the content of these safety outcomes.

STANDARD WORKPLACE SAFETY

A. Safety Legislation, Regulations & Industry Policy in the Trades

Outcome: ***Describe legislation, regulations and practices intended to ensure a safe work place in this trade.***

1. Demonstrate the ability to apply the Occupational Health and Safety Act, Regulation and Code.
2. Explain the role of the employer and employee in regard to Occupational Health and Safety (OH&S) regulations, Worksite Hazardous Materials Information Systems (WHMIS), fire regulations, Workers Compensation Board regulations, and related advisory bodies and agencies.
3. Explain industry practices for hazard assessment and control procedures.
4. Describe the responsibilities of workers and employers to apply emergency procedures.
5. Describe positive tradesperson attitudes with respect to housekeeping, personal protective equipment and emergency procedures.
6. Describe the roles and responsibilities of employers and employees with respect to the selection and use of personal protective equipment (PPE).
7. Select, use and maintain appropriate PPE for worksite applications.

B. Climbing, Lifting, Rigging and Hoisting

Outcome: ***Describe the use of personal protective equipment (PPE) and safe practices for climbing, lifting, rigging and hoisting in this trade.***

1. Select, use and maintain specialized PPE for climbing, lifting and load moving equipment.
2. Describe manual lifting procedures using correct body mechanics.
3. Describe rigging hardware and the safety factor associated with each item.
4. Select the correct equipment for rigging typical loads.
5. Describe hoisting and load moving procedures.

C. Hazardous Materials & Fire Protection

Outcome: ***Describe the safety practices for hazardous materials and fire protection in this trade.***

1. Describe the roles, responsibilities features and practices related to the workplace hazardous materials information system (WHMIS) program.
2. Describe the three key elements of WHMIS.
3. Describe handling, storing and transporting procedures when dealing with hazardous material.
4. Describe safe venting procedures when working with hazardous materials.
5. Describe fire hazards, classes, procedures and equipment related to fire protection.

Workplace Health and Safety

A tradesperson is often exposed to more hazards than any other person in the work force and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Workplace Health and Safety (Alberta Employment, Immigration and Industry) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at www.worksafely.org

Technical Training

Apprenticeship technical training is delivered by the technical institutes and many colleges in the public post-secondary system throughout Alberta. The colleges and institutes are committed to delivering the technical training component of Alberta apprenticeship programs in a safe, efficient and effective manner. All training providers place great emphasis on safe technical practices that complement safe workplace practices and help to develop a skilled, safe workforce.

The following institutions deliver Outdoor Power Equipment Technician apprenticeship technical training:

Northern Alberta Institute of Technology (Patricia Campus)

Procedures for Recommending Revisions to the Course Outline

Advanced Education has prepared this course outline in partnership with the Outdoor Power Equipment Technician Provincial Apprenticeship Committee.

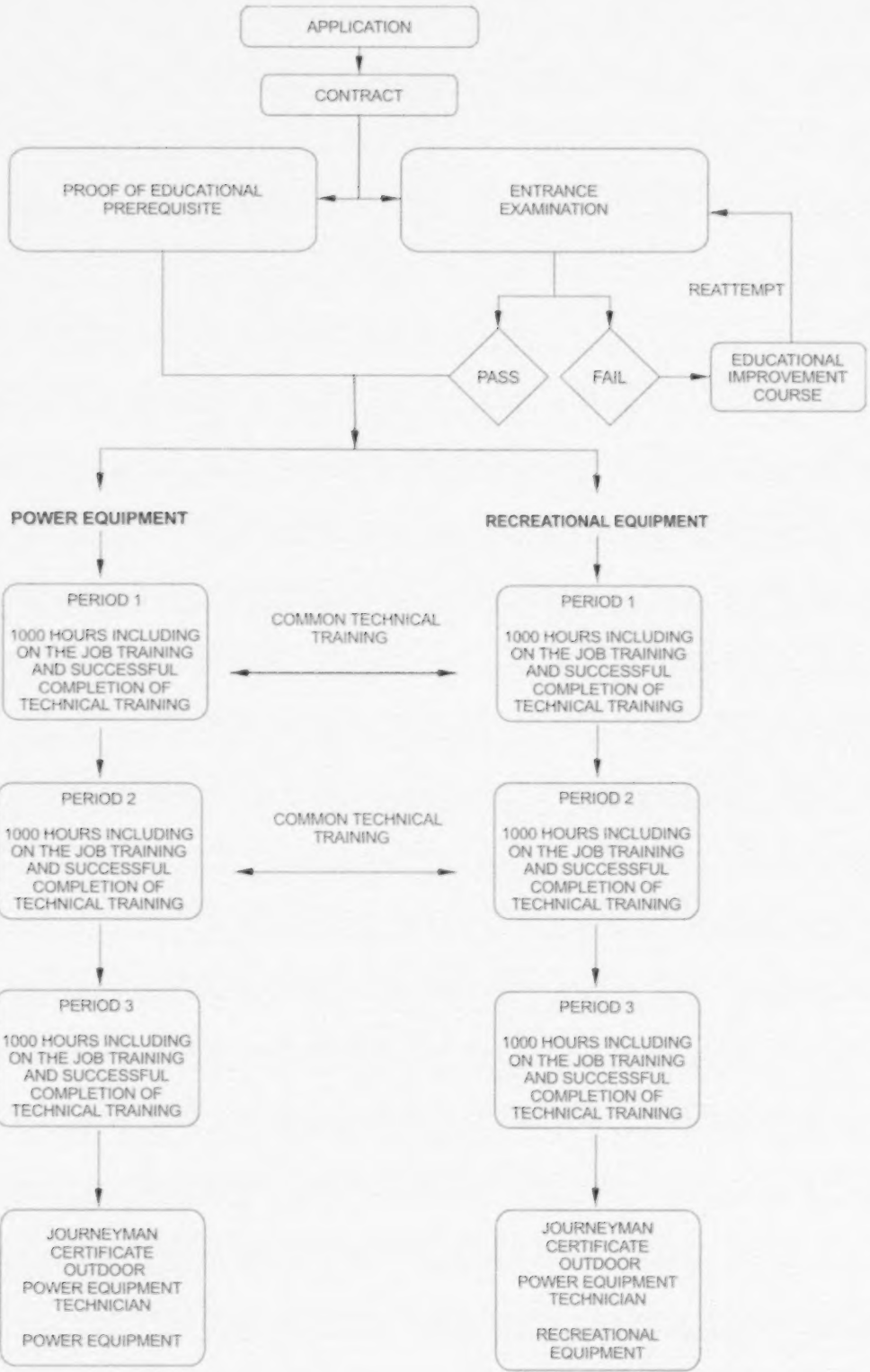
This course outline was approved on February 4, 2011 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

Outdoor Power Equipment Technician Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
Advanced Education
10th floor, Commerce Place
10155 102 Street NW
Edmonton AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used. Recommendations for change will be placed on the agenda for regular meetings of the Outdoor Power Equipment Technician Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification


APPLICATION
CONTRACT
PROOF OF EDUCATIONAL PREREQUISITE
ENTRANCE EXAMINATION
REATTEMPT
PASS
FAIL
EDUCATIONAL IMPROVEMENT COURSE
POWER EQUIPMENT
RECREATIONAL EQUIPMENT
PERIOD 1
1000 HOURS INCLUDING ON THE JOB TRAINING AND SUCCESSFUL COMPLETION OF TECHNICAL TRAINING
COMMON TECHNICAL TRAINING
PERIOD 1
1000 HOURS INCLUDING ON THE JOB TRAINING AND SUCCESSFUL COMPLETION OF TECHNICAL TRAINING
PERIOD 2
1000 HOURS INCLUDING ON THE JOB TRAINING AND SUCCESSFUL COMPLETION OF TECHNICAL TRAINING
COMMON TECHNICAL TRAINING
PERIOD 2
1000 HOURS INCLUDING ON THE JOB TRAINING AND SUCCESSFUL COMPLETION OF TECHNICAL TRAINING
PERIOD 3
1000 HOURS INCLUDING ON THE JOB TRAINING AND SUCCESSFUL COMPLETION OF TECHNICAL TRAINING
PERIOD 3
1000 HOURS INCLUDING ON THE JOB TRAINING AND SUCCESSFUL COMPLETION OF TECHNICAL TRAINING
JOURNEYMAN CERTIFICATE OUTDOOR POWER EQUIPMENT TECHNICIAN
POWER EQUIPMENT
JOURNEYMAN CERTIFICATE OUTDOOR POWER EQUIPMENT TECHNICIAN
RECREATIONAL EQUIPMENT

Outdoor Power Equipment Technician Training Profile
FIRST PERIOD
(6 Weeks 30 Hours per Week – Total of 180 Hours)

SECTION ONE

SHOP PRACTICE AND THEORY
18 HOURS

A	B	C
Measuring Tools 3 Hours	Fasteners 3 Hours	Materials 2 Hours
D	**E**	**F**
Service and Parts Manuals 3 Hours	Communication and Customer Service 2 Hours	Written Communication and Work Orders 3 Hours
G		
AIT Industry Network 2 Hours		

SECTION TWO

ELECTRICAL THEORY
36 HOURS

A	B	C
Electrical Safety for Outdoor Power Equipment 1 Hour	Testing Tools 3 Hours	Electrical Principles 12 Hours
D	**E**	**F**
Batteries 2 Hours	Electrical Circuits for Power Equipment 12 Hours	Electrical Wiring 6 Hours

SECTION THREE

FUEL SYSTEMS
36 HOURS

A	B	C
Fuels 2 Hours	Fuel Pumps Tanks and Lines 4 Hours	Carburetor 16 Hours
D		
Diesel 14 Hours		

SECTION FOUR

BEARINGS SEALS AND BASIC DRIVE SYSTEMS
24 HOURS

A	B	C
Bearings 5 Hours	Seals 2 Hours	Gear and Drive Ratios 1 Hour
D	**E**	**F**
Belt Drives 4 Hours	Chain Drives 1 Hour	Clutches 3 Hours
G	**H**	
Universal Joints 3 Hours	Differentials 5 Hours	

SECTION FIVE

ENGINES

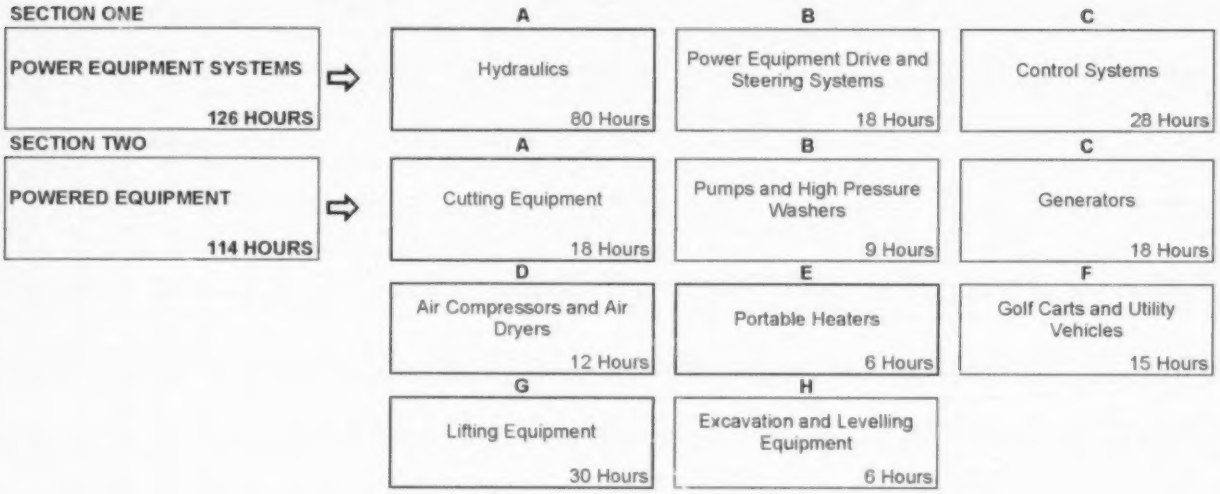
66 HOURS

A	B	C
Four Stroke Engines 16 Hours	Two Stroke Engines 16 Hours	Governors 6 Hours
D	**E**	**F**
Induction Systems 6 Hours	Oils 1 Hour	Oil Pumps 6 Hours
G	**H**	**I**
Filtration Systems 1 Hour	Lubrication Circuits 1 Hour	Two Stroke Lubrication 3 Hours
J	**K**	
Exhaust Systems 4 Hours	Emission Control 6 Hours	

SECOND PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

		A	B	C
SECTION ONE				
WHEELS BRAKES AND BASIC HYRAULICS 30 HOURS	⇨	Wheels and Tires 3 Hours	Brakes 21 Hours	Basic Hydraulics 6 Hours
SECTION TWO		A	B	
WELDING 24 HOURS	⇨	Set up Welding Equipment and Welding Safety 6 Hours	Operate Welding Equipment 18 Hours	
SECTION THREE		A	B	C
SPARK IGNITION SYSTEMS 30 HOURS	⇨	Magneto Ignition 6 Hours	Mechanical and Electronic Ignition Systems and Circuits 12 Hours	Ignition System Service and Troubleshooting 12 Hours
SECTION FOUR		A	B	
ELECTRONIC FUEL INJECTION 30 HOURS	⇨	Electronic Fuel Injection 15 Hours	Troubleshooting Electronic Fuel Injection Systems 15 Hours	
SECTION FIVE		A		
CHARGING SYSTEMS 18 HOURS	⇨	Charging Systems 18 Hours		
SECTION SIX		A	B	C
STARTING SYSTEMS 18 HOURS	⇨	Recoil Starters 6 Hours	Electric Starters 6 Hours	Troubleshoot Electric Start Systems 6 Hours
SECTION SEVEN		A	B	C
COOLING SYSTEMS 18 HOURS	⇨	Air Cooling 3 Hours	Liquid Cooling 12 Hours	Oil Cooling 3 Hours
SECTION EIGHT		A	B	
POWER UNIT TROUBLESHOOTING 72 HOURS	⇨	Troubleshooting Engine Running 30 Hours	Troubleshooting Engine Failure 42 Hours	

FINAL PERIOD – POWER TECHNICIAN
(8 Weeks 30 Hours per Week – Total of 240 Hours)



FINAL PERIOD – RECREATIONAL TECHNICIAN
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

RECREATIONAL EQUIPMENT FUEL SYSTEMS
30 HOURS

A	B	C
Recreational Equipment Carburetor Identification 2 Hours	Carburetion Troubleshooting 10 Hours	Jetting Principles 3 Hours

D
Direct Injection 15 Hours

SECTION TWO

RECREATIONAL EQUIPMENT TRANSMISSIONS
70 HOURS

A	B	C
Transmissions 20 Hours	Centrifugal Clutches 20 Hours	Multiplate Clutches 10 Hours

D
Marine Drive Shimming 20 Hours

SECTION THREE

RECREATIONAL ENGINE OVERHAULS
60 HOURS

A	B	C
Engine Repair Estimates 1 Hour	Measurement and Inspection 17 Hours	Recondition Parts 12 Hours

D	E
Reassembly of Engines 27 Hours	Testing of Rebuilt Engine and Final Adjustments 3 Hours

SECTION FOUR

MARINE RECREATIONAL EQUIPMENT
40 HOURS

A	B	C
Marine Fuel Supply Systems 1 Hour	Shifting 2 Hours	Transom Plates 3 Hours

D	E	F
Jet Drives 10 Hours	Power Trim 18 Hours	Props and Hulls 5 Hours

G
Marine Accessories 1 Hour

SECTION FIVE

OFF ROAD RECREATIONAL EQUIPMENT
40 HOURS

A	B	C
Track Drives 10 Hours	Steering 5 Hours	Shocks 4 Hours

D	E
ATV and Snowmobile Suspensions 11 Hours	Accessories 10 Hours

FIRST PERIOD TECHNICAL TRAINING
OUTDOOR POWER EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE.....SHOP PRACTICE AND THEORY ..... 18 HOURS

A. Measuring Tools .....3 Hours

Outcome: ***Make accurate measurements using measuring tools.***

1. Machinists rules, straight edge
2. Tape measure
3. Micrometers (inside, outside, depth) digital and conventional
4. Telescoping gage
5. Calipers (vernier dial and digital)
6. Dial indicators
7. Surface plates, levelling plates, machinists squares etc.
8. Feeler gage, hole gage, thread gage
9. Compression gage, vacuum gage, pressure gages
10. Crankcase and cylinder head leak or leakdown testers
11. Torque wrenches
12. Plasti gage, mechanics dye etc.
13. Timing lights
14. Tachometers
15. Engine and system diagnostic tools, scopes, scanners, code readers
16. PC or laptop computers with diagnostic interfaces and software.

B. Fasteners.....3 Hours

Outcome: ***Identify, remove, and replace fasteners according to manufacturer or industry specifications.***

1. Identify metric and US standard threaded fasteners by:
   a) thread type and class
   b) thread pitch
   c) length and diameter
   d) head type.
2. Install threaded fasteners using manufacturer or industry torque tables and tightening patterns.
3. Describe the use of thread locking methods, including:
   a) lock nuts
   b) lock washers
   c) anaerobic thread lockers
   d) cotter pins, etc.
4. Remove and replace non threaded fasteners (snap rings, etc.)
5. Install pop rivets, remove rivets.

C. Materials ..... 2 Hours

Outcome: ***Identify broad classes of power equipment frame materials; identify repair/replacement/modifications options for materials used in power equipment.***

1. Identify the types of materials used for outdoor power equipment, wheeled vehicles, wheeled equipment, tracked vehicles, trailers, frames, booms, masts and mounts:
   a) ferrous and non ferrous alloys
   b) tubing
   c) castings
   d) fabricated sheet
   e) plastics
   f) other, composites ceramics, etc.
2. Describe the function of frames and frame components common to Outdoor Power Equipment.
3. Identify frame damage and describe repair / replacement options for:
   a) wheeled utility vehicles and golf carts
   b) snowmobiles – tracked vehicles
   c) trailers
   d) other wheeled equipment
   e) stationary and portable equipment
   f) lifting equipment.
4. Describe non destructive testing (NDT).
   a) What needs to be tested using NDT?
   b) Who performs NDT testing?

D. Service and Parts Manuals ..... 3 Hours

Outcome: ***Use service manuals and parts manuals to find service procedures and parts numbers.***

1. Using model identification, serial number etc., locate and access the correct service manual and parts manual for outdoor power equipment.
2. Access manuals using the following methods:
   a) print
   b) digital media
   c) computer terminal, internet, or other on line systems
   d) microfiche.
3. Describe the need to identify and determine model number, serial number, etc. of equipment before starting any work.
4. Use service manuals to find:
   a) maintenance intervals and procedures
   b) capacities
   c) service and repair procedure
   d) specifications etc.
5. Describe the difference in repair and documentation between a warranty repair and a non warranty repair.
6. Use parts manuals to identify parts, part numbers and components.
7. Describe a typical parts ordering procedure for outdoor power equipment.

E. Communications-Customer Service ..... 2 Hours

Outcome: ***Communicate clearly with customers, supervisors technicians and apprentices regarding the operation, service and repair of outdoor power equipment.***

1. Identify the classes of customers encountered in the outdoor power equipment industry:
   a) retail customers
   b) wholesale customers
   c) rental customers
   d) internal customers
   e) primary contact customer service (face to face contact)
   f) secondary contact customer (phone, fax, email, EDI etc.,).
2. Describe the workplace coaching and mentoring skills used to train on the job.
3. Compare the differences, costs and benefits of retaining customer's vs. the costs and benefits of gaining new customers.
4. Identify effective techniques for dealing with difficult situations with customers:
   a) angry customers
   b) impatient customers
   c) indecisive customers
   d) other situations.
5. Describe techniques for recovering 'lost' customers.

F. Written Communication and Work Orders ..... 3 Hours

Outcome: ***Be able to take and complete work orders for the repair and service of outdoor power equipment.***

1. Describe the information required to complete a work order.
2. Complete the information required for a work order with a customer.
3. Enter work completed, parts installed comments etc. on work orders.
4. Prepare an estimate for repairs, service procedures, etc.
5. Prepare paper work etc., for warranty repairs.
6. Complete an engine or equipment evaluation form.
7. Describe technician productivity and efficiency ratings.

G. AIT Industry Network ..... 2 Hours

Outcome: ***Describe the role of the Alberta Apprenticeship and Industry Training board and the network of industry committees that represent the trades and occupations in Alberta.***

1. Describe Alberta's apprenticeship and industry training system.
2. Describe the roles and responsibilities of the Alberta Apprenticeship and Industry Training Board, government and post-secondary institutions.
3. Describe the roles and responsibilities of the PAC's, LAC's and Occupational Committees.

SECTION TWO ..... ELECTRICAL THEORY ..... 36 HOURS

A. Electrical Safety for Outdoor Power Equipment ..... 1 Hour

Outcome: ***Describe the safe work practices for electrical power tools, outdoor power system electrical systems, portable generators.***

1. Describe what is meant by CSA/UL labels-for electrical equipment.
2. Describe the dangers of working with AC line or generator current (110-600 VAC).
3. Describe the dangers of DC current.
4. Describe the hazards associated with overloaded or shorted wires.
5. Describe when and where an electrician is needed to perform electrical tasks.

B. Testing Tools ..... 3 Hours

Outcome: ***Identify and describe the use of electrical testing tools.***

1. Describe electrical testing equipment.
   a) Multi meters
   b) Inductive meters
   c) Continuity testers
   d) Megger
   e) Battery testers and chargers
2. Describe the need for high impedance testing equipment for digital circuits.

C. Electrical Principles ..... 12 Hours

Outcome: ***Describe the basic electrical circuit, define resistance voltage and amperage, calculate power calculate voltage resistance or amperage.***

1. Describe the following:
   a) electrical safety
   b) voltage
   c) amperage
   d) resistance
   e) conductors and insulators
   f) AC and DC.
2. Calculate power (watts) given voltage and amperage.
3. Calculate voltage, amperage and resistance in a circuit using the formula V=IR.
4. Measure voltage, amperage and resistance using meters.

D. Batteries ..... 2 Hours

Outcome: ***Perform battery maintenance, storage removal and installation.***

1. Describe battery types and construction used in outdoor power equipment.
2. Prepare batteries for service, fill with electrolyte and charge where applicable.
3. Describe battery disposal.
4. Test and Diagnose battery condition, charge and specific gravity (if applicable).
5. Describe battery chargers and how to operate them.
6. Describe battery short and long term storage.

7. Describe battery installation.
8. Describe battery maintenance, maintain electrolyte levels, checking for corrosion, sulphation etc.

E. Electrical Circuits for Power Equipment ..... 12 Hours

Outcome: ***Describe the basic electrical circuit types and circuit faults typical for outdoor power equipment.***

1. Define the basic electrical circuit types and their faults, including:
   a) series circuit
   b) parallel circuit
   c) grounding
   d) short
   e) open
   f) loads
   g) switches
   h) fuses and circuit breakers.
2. Describe outdoor power equipment circuits including:
   a) ignition circuit with interlocks
   b) charging circuit
   c) aftermarket accessory circuits
   d) electric trailer brake circuit
   e) winch circuit using relays
   f) battery operated starting motor
   g) line voltage starting motor
   h) lighting circuits
   i) warning light and instrumentation circuits
   j) instrument gages
   k) ECU Sensor circuits
   l) CAN bus circuits.

F. Electrical Wiring..... 6 Hours

Outcome: ***Install or repair electrical circuit components on outdoor power equipment.***

1. Describe electrical wire and insulation types and sizes and how to select the correct wire for a circuit and application.
2. Disassemble and reassemble electrical components and wiring harnesses.
3. Inspect wires, insulation, connectors, harnesses, ties, grommets, heat shields etc. for faults and or damage.
4. Describe soldering of electrical components including:
   a) solder type
   b) flux type and purpose of flux
   c) heat sources, heat requirements for soldering
   d) preparation of solder joint, components to be joined.
5. Prepare wire for connections (strip insulation, clean as applicable).
6. Make a soldered electrical joint.
7. Replace or install solder less wire connections common to outdoor power equipment.

8. Construct a 12 volt circuit featuring loads in parallel, a relay, a fuse and an indicator (power) light, and a switch.
9. Using test equipment, troubleshoot a circuits for faults such as:
   a) short
   b) open
   c) ground fault
   d) faulty switches
   e) faulty components
   f) faulty connections, plugs.

SECTION THREE ..... FUEL SYSTEMS ..... 36 HOURS

A. Fuels ..... 2 Hours

Outcome: ***Describe the fuels used for outdoor power equipment.***

1. Describe the characteristics of power equipment fuels, including:
   a) gasoline
   b) diesel/kerosene
   c) LPG (propane)
   d) alcohol / gasohol.
2. Describe what is meant by octane or cetane ratings for fuels.
3. Describe the difference between summer and winter blended fuels as it applies to Alberta and outdoor power equipment.
4. Describe quality and safety concerns for fuel storage including:
   a) gasoline
   b) diesel/kerosene
   c) LPG (propane)
   d) alcohol / gasohol.
5. Explain the requirements for fuel tanks, lines and filters for the following fuel types:
   a) gasoline
   b) diesel/kerosene
   c) LPG (propane)
   d) alcohol / gasohol.
6. Describe service procedures for high-pressure fuel delivery systems.
7. Describe considerations for alcohol based fuels pertaining to:
   a) water absorption
   b) compatibility with components or materials found in some fuel delivery systems.

B. Fuel Pumps Tanks and Lines ..... 4 Hours

Outcome: ***Service small engine fuel supply systems.***

1. Describe small engine fuel pumps, including:
   a) mechanical
   b) electrical
   c) pulsation.
2. Describe fuel system tanks, tank mounting, fuel lines, and safety devices.
3. Test, diagnose and troubleshoot small engine fuel delivery systems.

C. Carburetor ..... 16 Hours

Outcome: ***Service small engine carburetors***

1. Explain how a small engine carburetor works, including:
   a) venturi
   b) jets and needles
   c) float
   d) throttle – air control
   e) idle, high speed and low speed circuits
   f) cold start systems, chokes and enricheners.
2. Identify and describe the common types of carburetors including:
   a) butterfly
   b) slide
   c) constant velocity
   d) diaphragm
   e) side draft up draft down draft.
3. Describe dual fuel systems.
4. Disassemble evaluate condition and recondition small engine carburetor, set float, needle position etc.

D. Diesel ..... 14 Hours

Outcome: ***Service compression ignition fuel systems used in outdoor power equipment.***

1. Describe the diesel combustion process.
2. Describe the operation of glow plugs and preheaters.
3. Describe the fundamental operation and design features of diesel fuel injection systems and related components.
   a) lines and fittings
   b) filters
   c) pumps
4. Describe the diesel injector.
5. Remove test and install diesel fuel injectors.
6. Remove air trapped in a diesel fuel system.
7. Remove, inspect, install and time diesel injector pump.

SECTION FOUR ..... BEARINGS SEALS AND BASIC DRIVES ..... 24 HOURS

A. Bearings ..... 5 Hours

Outcome: ***Remove, service and replace bearings on outdoor power equipment.***

1. Describe plain bearings:
   a) bushings impregnated and non impregnated.
   b) insert / shell
   c) thrust washers
   d) plain bearing materials /brass bronze white metal
   e) wear pads.

2. Describe roller or antifriction bearings:
   a) ball
   b) roller
   c) needle
   d) tapered roller
   e) thrust bearings
   f) bearing identification and ordering.
3. Describe what is meant by radial and axial loads and compare the characteristics of bearing types for radial and axial loads.
4. Describe other bearing types, such as sprag clutches, and CVT components.
5. Describe bearing lubrication requirements for the various classes of bearings.
6. Remove anti friction bearings, clean, inspect pack, install.
7. Adjust tapered roller bearings (eg., wheel bearings).
8. Remove, replace and when applicable, finish size plain bearings.
9. Diagnose common bearing faults.

B. Seals ..... 2 Hours

Outcome: ***Remove and replace seals on outdoor power equipment.***

1. Describe the operating characteristics of the following types and classes of seals:
   a) gaskets – paper- neoprene – composite - metal
   b) O rings, quad rings, X rings
   c) sealants – gasket compounds
   d) lipped seals
   e) labyrinth seals
   f) piston rings
   g) ceramic seals
   h) other seal types.
2. Remove, and replace gaskets and seals in outdoor power equipment.
3. Describe generic seal and sealant identification and ordering.

C. Gear and Drive Ratios ..... 1 Hour

Outcome: ***Given diameters or number of gear teeth, calculate gear and drive ratios.***

1. Explain the need for reduction ratios in terms of the relationship of torque and power.
2. Calculate gear sprocket and pulley ratios.
3. Describe the effect on rotation of selecting gears or sprockets and pulleys to transmit rotary motion.

D. Belt Drives ..... 4 Hours

Outcome: ***Service belt drive systems.***

1. Describe belt drive systems found in power equipment:
   a) construction
   b) sizing
   c) application
   d) V belts
   e) Toothed belts.

2. Describe CVTs.
3. Inspect, adjust, align and tension a belt drive.
4. Inspect evaluate and replace pulley system if required.
5. Diagnose belt drive failures.

E. Chain Drives ..... 1 Hour

Outcome: ***Service chain drive systems.***

1. Describe the chain drive types found in power equipment:
   a) Roller
   b) O ring roller
   c) Hyvo (silent).
2. Describe chain and sprocket sizing convention.
3. Describe lubrication requirements for each chain type.
4. Describe chain connectors, riveted and master links and chain breakers.
5. Evaluate condition, remove and replace chains and sprockets.
6. Adjust chain for tension and alignment.

F. Clutches ..... 3 Hours

Outcome: ***Describe outdoor power equipment clutches, service hand held equipment centrifugal clutches.***

1. Describe the operation of clutches common to outdoor power equipment:
   a) centrifugal
   b) multiplate
   c) single plate
   d) wet
   e) dry.
2. Describe the component parts of handheld equipment centrifugal clutches.
3. Remove replace and adjust (if applicable) a handheld centrifugal clutch.

G. Universal Joints ..... 3 Hours

Outcome: Service Universal Joints.

1. Describe cardan and constant velocity universal joints.
2. Determine universal joint wear or damage.
3. Remove and replace faulty universal joints.

H. Differentials ..... 5 Hours

Outcome: ***Service differentials.***

1. Describe the purpose and function of differentials.
2. Explain differential operations.
3. List differential components.
4. Inspect and adjust differential.

SECTION FIVE ..... ENGINES ..... 66 HOURS

A. Four Stroke Internal Combustion Theory ..... 16 Hours

Outcome: ***Describe the components and operation of small engines.***

1. Describe the basic four stroke engine:
   a) intake, compression, combustion, exhaust
   b) piston, connecting rod crankshaft
   c) crankcase, cylinder, cylinder head
   d) camshaft, lifters, valves
   e) side valve, overhead valve, overhead cam.
2. Describe ignition timing for flywheel magneto ignition systems.
3. Disassemble a small four stroke engine.
4. Evaluate condition of valves, piston rings, cylinder, crankshaft, main, rod and small end bearings.
5. Reassemble engine, set valves, carburettor, timing, governor etc.

B. Two Stroke Engines ..... 16 Hours

Outcome: ***Describe the components and operation of two stroke engines.***

1. Describe two stroke engine design, including:
   a) two stroke operation
   b) pre mix fuel to oil ratios
   c) injector pumps
   d) piston ported
   e) reed valve
   f) rotary valve
   g) variable exhaust port timing
   h) crankcase sealing
   i) built up crankshafts
   j) transfer ports
   k) loop charged
   l) deflector top pistons
   m) exhaust scavenging.
2. Disassemble small two stroke engines.
3. Evaluate condition of piston rings, cylinder, crankshaft assembly, reed, rotary, power etc. valves (if present).
4. Decarbonise if required.
5. Reassemble engine, set carburettor, timing, etc.

C. Governors ..... 6 Hours

Outcome: ***Service small engine governors.***

1. Describe engine speed control for utility engines.
2. Describe air vane and mechanical governors.
3. Adjust engine governor for no load rpm and load rpm.

D. Induction Systems ..... 6 Hours

Outcome: ***Service outdoor power equipment air intake systems.***

1. Describe the characteristics of the following air filters:
   a) paper
   b) foam
   c) oil bath
   d) mesh – other.
2. Describe naturally aspirated intake systems.
3. Describe the effect of intake length in relation to engine performance and design.
4. Describe the purpose and design features of intake manifolds.
5. Describe forced air induction:
   a) turbo chargers
   b) super chargers.
6. Describe positive air shut off systems.
7. Service air cleaners and intake system components.

E. Oils ..... 1 Hour

Outcome: ***Describe the need for lubrication, properties of lubricants, lubrication systems used for outdoor power equipment.***

1. Describe lubrication and the role of oil in cooling and the removal of wear particles.
2. Describe the lubrication requirements of bearings, gears, and sliding parts including:
   a) plain bearings
   b) frictionless bearings
   c) gear teeth
   d) pistons, cylinders.
3. List and briefly describe power equipment lubrication requirements including:
   a) two stroke crankcase induction engines
   b) four stroke engines
   c) transmissions/gear cases/differentials
   d) suspensions
   e) drive components
   f) auxiliary drive components
   g) cables control rods etc.
4. Identify types and grades of oils, greases, other lubricants by API and SAE classification.
5. Describe the meaning of viscosity ratings and oil service conditions and classifications.

F. Oil Pumps ..... 6 Hours

Outcome: ***Service oil pumps.***

1. Identify and the following oil circulation systems:
   a) splash
   b) gear
   c) piston
   d) trochoid.
2. Distinguish between wet and dry sump lubrication systems.

3. Describe oil pressure requirements for engine components
   a) plain bearing
   b) frictionless bearing
   c) sliding parts
   d) high load vs. low load.
4. Remove, inspect, recondition or replace oil pumps.
5. Test oil pressure.
6. Explain how oil pressure can be used to diagnose engine condition.

G. Filtration Systems ..... 1 Hour

Outcome: ***Service oil pumps and lines.***

1. Describe the operation of oil filters including:
   a) full and partial flow
   b) bypass system
   c) element construction
   d) centrifugal.
2. Locate, remove replace or clean the following filter types:
   a) removable - disposable
   b) centrifugal
   c) magnetic drain plug, other.

H. Lubrication Circuits ..... 1 Hour

Outcome: ***Service lubrication lines, passages and seals.***

1. Identify and service the following lubrication circuit components:
   a) relief valves
   b) bypass valves
   c) metering orifices
   d) oil lines.
2. Describe oil pressure monitoring systems:
   a) direct pressure gage
   b) electrical sensors
   c) pressure warning light
   d) electrical pressure gage
   e) other indicators of oil pressure problems.
3. Examine, evaluate condition, service internal and external oil lines passages seals etc.
4. Remove and replace oil pressure sensors indicators and valves.

I. Two-Stroke Lubrication ..... 3 Hours

Outcome: ***Service two stroke lubrication systems.***

1. Describe two-stroke lubrication:
   a) premix ratios
   b) injector systems
   c) injector pump operation and adjustment.

J. Exhaust Systems ..... 4 Hours

Outcome: ***Service exhaust and systems.***

2. Describe the purpose and function of an exhaust system.
3. Describe outdoor power equipment exhaust noise control, including legal or liability concerns.
4. Describe how engine sound levels are measured.
5. Describe two cycle exhaust systems, tuned exhausts / expansion chambers.
6. Describe four cycle exhaust systems:
   a) dry
   b) wet.
7. Remove and replace exhaust systems and exhaust system components.
8. Inspect and correct exhaust system components for:
   a) damage – leaks - corrosion
   b) carbon build up
   c) malfunction (muffler – catalytic converters)
   d) functioning heat shields spark arrestors etc.

K. Emission Control ..... 6 Hours

Outcome: ***Service emission control systems.***

1. Describe the Canadian and Alberta legal requirements for emission control for outdoor power equipment.
2. Explain the trend towards tightened emission control laws for outdoor power equipment.
3. Describe exhaust emission control devices:
   a) PCV systems
   b) catalytic converters
   c) spark arrestors
   d) engine management systems
   e) other emission control devices.
4. Use an exhaust gas analyzer to measure exhaust gas on outdoor power equipment how engine emissions are measured.

SECOND PERIOD TECHNICAL TRAINING
OUTDOOR POWER EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE ..... WHEELS, BRAKES, AND BASIC HYDRAULICS ..... 30 HOURS

A. Wheels and Tires ..... 3 Hours

Outcome: ***Describe wheel and tire service alignment.***

1. Describe tires, treads and directional treads.
2. Describe tire fillers.
3. Check equipment wheel alignment.
4. Inspect tires for wear and load rating.
5. Remove and replace trailer tires.

B. Brakes ..... 21 Hours

Outcome: ***Inspect, remove, service and replace brakes.***

1. Describe braking systems commonly found on outdoor power equipment:
   a) drum brakes
   b) disk brakes
   c) mechanical operation
   d) hydraulic operation
   e) electric brakes
   f) inboard brakes
   g) wheel mounted brakes
   h) jackshaft mounting
   i) wet brakes
   j) other brakes (e.g. engine brake – blade brakes).
2. Describe brake operated steering.
3. Service hydraulic braking system, including:
   a) inspect brake fluid levels, bleed brake system, maintain correct fluid levels
   b) remove and replace brake shoes from a drum brake system
   c) remove and replace brake pads from a disk brake system
   d) evaluate condition of brake shoes, pads, drums and disks
   e) remove disassemble, recondition and re-assemble master cylinder, slave cylinder, disk calipers
   f) adjust mechanical linkages, cables, drum brake shoes etc.
4. Describe trailer brake operation.
   a) electric controllers – types, wiring and operation
   b) inertial controllers
   c) surge brakes
   d) electric over hydraulic
   e) breakaway system

5. Describe Alberta Traffic Safety requirements for trailer brakes on public highways.
6. Troubleshoot trailer brake system.

C. Basic Hydraulics ..... 6 Hours

Outcome: Describe basic hydraulic systems.

1. State the safety precautions that must be observed when working with hydraulics.
2. Explain hydraulic principles of pressure, force, area, volume, power, and flow rate cycle times using mathematical calculations.
3. Identify the common components, fluids and fittings found in simple hydraulic systems.

SECTION TWO ..... WELDING ..... 24 HOURS

A. Set up Welding Equipment and Welding Safety ..... 6 Hours

Outcome: Set up and adjust welding torches and mig welder.

1. Describe the hazards associated with welding equipment and operating welding equipment.
2. Describe the hazards associated with welding fumes, vapours, UV rays, etc.
3. Describe the oxyacetylene welding and cutting fittings and component assembly and disassembly.
4. Describe backfires, flashbacks etc. and how they are prevented.
5. Describe regulator and flame adjustments; identify neutral, oxidizing and carburizing flames.
6. Assemble and set up portable MIG welders.
7. Inspect MIG welder component condition and correct if required.
8. Describe MIG welder adjustment.

B. Operate Welding Equipment ..... 18 hours

Outcome: Perform basic welds using oxyacetylene and MIG welders.

1. Cut mild steel using oxyacetylene equipment.
2. Make a brazed lap joint using oxyacetylene equipment.
3. Make the following welds using a MIG welder on mild steel, 6 mm to 1.2 mm:
   a) stringer beads
   b) butt weld
   c) lap weld
   d) corner and fillet
   e) spot welds.

SECTION THREE ..... SPARK IGNITION SYSTEMS ..... 30 HOURS

A. Magneto Ignition ..... 6 Hours

Outcome: Service magneto ignition systems.

1. Describe how a magneto ignition system works.
2. Describe how a CDI magneto works.
3. Identify the components of the magneto ignition system.

4. Describe how a timed spark is produced by a magneto:
   a) points system
   b) solid state system.
5. Test magneto operation.
6. Inspect, recondition, replace, adjust, magneto components.

B. Mechanical and Electronic Ignition Systems and Circuits ..... 12 Hours

Outcome: ***Service ignition circuits.***

1. Describe the operation of an inductive coil ignition system.
2. Describe methods for controlling ignition timing:
   a) points
   b) electronic/breakerless
   c) engine management systems.
3. Describe the purpose of spark advance.
4. Describe methods of producing spark advance:
   a) mechanical
   b) electronic
   c) engine management system.
5. Describe the components of the high voltage circuit:
   a) coils
   b) high tension leads
   c) distributor and components.
6. Describe spark plug construction.
7. Describe and identify spark plug heat range.

C. Ignition, System Service and Troubleshooting ..... 12 Hours

Outcome: ***Service and troubleshoot ignition and interlock systems.***

1. Describe ignitions and starting systems interlocks:
   a) mechanical
   b) electrical.
2. Test and repair ignitions systems and interlocks.
3. Describe legal and liability issues of disabling or modifying interlock systems.
4. Service or replace ignition components:
   a) spark plugs
   b) distributors
   c) points
   d) pickup/sensors
   e) coils
   f) modules
   g) connections, wiring.

SECTION FOUR ..... ELECTRONIC FUEL INJECTION ..... 30 HOURS

A. Electronic Fuel Injection ..... 15 Hours

Outcome: ***Service outdoor power equipment EFI systems***

1. Describe the basic principles of electronic fuel injection including:
   a) basic components common to EFI systems
   b) multiport vs. single point delivery.
2. Explain the speed density and mass air flow of air measurement and identify the fuel injection system where each is used.
3. Explain purpose operation and location of fuel injectors.
4. Explain how air fuel mixtures are altered for various engine operating conditions.
5. Explain purpose, construction, location and operation of various air mass measuring devices.
6. Test system pressure, operation of fuel delivery system.

B. Troubleshoot EFI Systems ..... 15 Hours

Outcome: ***Troubleshoot EFI system.***

1. Troubleshoot EFI systems using the following as applicable:
   a) OEM error codes
   b) scan tools
   c) standard electrical test equipment (VOMs test lights etc.)
   d) built in OEM scan tests.
2. Correct, reset and verify faults.

SECTION FIVE..... CHARGING SYSTEMS..... 18 HOURS

A. Alternators..... 18 Hours

Outcome: ***Service alternators and generators, troubleshoot charging systems.***

1. Describe how electricity is generated by an alternator and a generator.
   a) permanent magnet single phase
   b) permanent magnet three phase
   c) electromagnetic rotor three phase
2. Describe voltage regulation systems.
3. Identify the components and location of components of a charging system.
4. Perform tests on charging system including the following components:
   a) stator
   b) rotor
   c) rectifier assembly
   d) slip ring and brushes
   e) regulators
   f) integrated charing system control modules.
5. Service alternator and generator drive systems (belts mounts etc.)
6. Test charging systems for output voltage and amperage.

7. Identify outputs, open and short circuits in charging circuit, grounding in wiring.
8. Troubleshoot alternators, generators and regulators, locate faults and assess need to replace or overhaul alternators or components.

SECTION SIX: ..... STARTING SYSTEMS ..... 18 HOURS

A. Recoil Starters ..... 6 Hours

Outcome: ***Service outdoor power equipment manual systems.***

1. Describe outdoor power equipment manual start systems.
2. Disassemble, inspect, clean, repair-replace components as required, install recoil starters.

B. Electric Starters ..... 6 Hours

Outcome: ***Service outdoor power equipment electric start systems.***

1. Describe outdoor power equipment electric start systems:
   a) battery operated electric start
   b) 110 volts (line voltage) electric start.
   c) combination starter generator systems.
2. Describe starter drives.
3. Describe the components found in electric starter circuits:
   a) key, ignition switch
   b) interlocks
   c) relay
   d) solenoid
   e) ignition by-pass
   f) battery cables.
4. Remove, inspect and replace electric start motors, relays solenoids (if applicable).

C. Troubleshoot Electric Starting Systems ..... 6 Hours

Outcome: ***Troubleshoot and correct starter problems.***

1. Find the cause of starter problems using the following tests or procedures:
   a) battery and cable condition
   b) amp draw
   c) voltage drop
   d) rpm
   e) operation of switches, solenoids, automated systems.

SECTION SEVEN: ..... COOLING SYSTEMS ..... 18 HOURS

A. Air Cooling ..... 3 Hours

Outcome: ***Evaluate and service air cooling systems and components of outdoor power equipment.***

1. Describe principles of heat transfer.
2. Describe air-cooling systems including:
   a) engine finning
   b) fans and shrouding.

3. Service air cooling components including:
   a) fins
   b) fans
   c) air shrouding and components.

B. Liquid Cooling.....12 Hours

Outcome: ***Service liquid cooling systems and components.***

1. Describe liquid cooling systems including:
   a) principle of operation
   b) radiator operation – construction materials
   c) coolants, mixing ratios, corrosion and inhibitors
   d) thermostats
   e) water pumps
   f) fans, direct drive, thermostatic and electric
   g) block heaters.
2. Describe a typical liquid cooling driven heating system.
3. Replace or repair, liquid cooling components including:
   a) pressure
   b) thermostats
   c) flush and refill coolant
   d) water pump
   e) hoses and or passageways.

C. Oil Cooling.....3 Hours

Outcome: ***Service liquid cooling systems and components.***

1. Describe oil cooling / heat exchangers and their applications including:
   a) engine oil cooler
   b) transmission oil cooler
   c) power steering or hydraulic oil cooler
   d) external lines and fittings.
2. Replace or repair oil cooling components.

SECTION EIGHT .....POWER UNIT TROUBLESHOOTING ..... 72 HOURS

A. Troubleshooting Running Engine..... 30 Hours

Outcome: ***Determine the cause of power unit problems and failures.***

1. For an engine that runs poorly or will not run determine and locate the cause.
2. Describe the three requirements for engine operation:
   a) compression
   b) fuel
   c) ignition.
3. Troubleshoot and correct fuel and air problems.
4. Troubleshoot diesel fuelling problems.
5. Troubleshoot and correct engine management interlock systems.

6. Troubleshoot exhaust and emissions problems.

7. Examine spark plugs and assess the following by reading spark plugs:

   a) carburetion
   b) oil consumption
   c) overheating
   d) detonation – pre-ignition
   e) engine/cylinder operating properly.

8. Perform a leak down or compression test and use the test results to diagnose engine component condition.

9. For an engine that tested good for adequate compression, fuel and spark check and adjust where appropriate:

   a) valve clearances
   b) ignition timing
   c) carburetor settings where applicable
   d) engine idle speed
   e) governor settings
   f) control linkages
   g) accessory drive belts timing belts/chains
   h) sensor condition, operation where applicable.

10. For a diesel engine tested for adequate compression and fuel check and adjust:

    a) valve clearances
    b) injector timing
    c) engine idle speed
    d) governor settings
    e) control linkages
    f) accessory drive belts timing belts/chains
    g) sensor condition, operation where applicable.

B. Troubleshooting Engine Failures ..... 42 Hours

Outcome: ***Evaluate condition of engine.***

1. Perform visual inspection of engine, assess for signs of damage, wear, leakage etc.

2. Determine why an engine has no compression.

3. For an engine that has failed, disassemble and determine cause of failure.

4. For a new or rebuilt engine verify that all engine internal and external systems are operating properly.

   a) check for leaks
   b) verify engine performance and output are within specification.
   c) check for loose fasteners etc., after initial run in.

FINAL PERIOD POWER BRANCH TECHNICAL TRAINING
OUTDOOR POWER EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE..... POWER EQUIPMENT SYSTEMS ..... 126 HOURS

A. Hydraulics ..... 80 Hours

Outcome: ***Service hydraulic systems.***

1. Explain basic hydraulic principles related to hydraulic pumps.
2. Explain the principles of operation and application of a typical gear pump.
3. Explain the principles of operation and application of a typical piston type hydraulic pump.
4. Explain the principles of operation and application of a typical vane pump.
5. Explain the principle of gear, vane and piston hydraulic motors.
6. Explain the operation and application of a typical gear, vane, and piston hydraulic motors.
7. Remove, disassemble, inspect, reseal, repair, and replace components of hydraulic motors.
8. Explain the operation and applications of hydraulic cylinders:
   a) double acting
   b) single acting
   c) balanced
   d) unbalanced.
9. Dismantle, inspect, reseal, and re-assemble hydraulic cylinders.
10. Describe properties of hydraulic fluid and criteria of its selection.
11. State the functions of the hydraulic reservoir and its related components.
12. State the function and principles of operation of filtration devices.
13. State the function and application of hydraulic heat exchangers.
14. Describe the principles and applications of basic hydraulic control valves:
    a) spool valve
    b) check valve
    c) shuttle valve
    d) manual valve.
15. Describe electric over hydraulic control valve systems.
16. Troubleshoot control valve operation.
17. Describe the function and principles of operation of direct acting pressure valve pilot control valves.
18. Describe flow dividers and combiners.
19. Define fluid drives.
20. Explain function and operating principles.
21. Describe the components of a fluid drive.
22. Describe differential drives.
23. Disassemble and assemble basic fluid drive.

24. Use a systematic procedure to diagnose common faults in a hydraulic system.
25. Identify the cause and common failures of hydraulic system components.
26. Assess performance and troubleshoot components of a basic hydraulic system.
27. Use systematic procedures to diagnose common faults.
28. Test a complete hydraulic system.

B. Power Equipment Drive and Steering Systems ..... 18 Hours

Outcome: ***Service and maintain power equipment drive systems, troubleshoot faults, determine corrective action.***

1. Describe the operation of automatic transmissions.
2. Perform automatic transmission maintenance as required.
3. Troubleshoot malfunctioning automatic transmission, determine fault and corrective action.
4. Describe the operation of CVT transmissions.
5. Perform required maintenance and adjustments on CVT transmissions.
6. Trouble shoot malfunctioning CVTs, determine fault and corrective action.
7. Maintain, adjust and trouble shoot shift mechanisms
8. Describe PTO operation and safety requirements.
9. Maintain PTOs, determine condition of components and corrective action if required.
10. Maintain and service final drives components.
11. Describe planetary torque hubs.
12. Describe steering mechanisms used for all classes of mobile power equipment:
    a) articulated
    b) skid or brake steering
    c) rack and pinion
    d) recirculating ball
    e) two wheel, four wheel, rear wheel, front wheel steering systems.
    f) power assisted
    g) steer-by-wire.
13. Inspect, adjust, maintain and repair steering components.

C. Control Systems. ..... 28 Hours

Outcome: ***Describe power system control systems.***

1. Describe safety protection controls found in power equipment.
2. Describe the function of controls to prevent damage to power equipment components and power units.
3. Describe mechanical, electrical, hydraulic controls.
4. Describe and electric control systems.
5. Describe electric over mechanical control systems.
6. Describe electric over hydraulic control systems.
7. Describe mechanical control systems.
8. Describe mechanical over hydraulic control systems.
9. Describe ECU managed control systems.

10. Describe procedures to determine whether equipment faults are caused by the control system or equipment components.
11. Troubleshoot control system faults.
12. Describe how to use OEM manuals, flow charts, wiring diagrams, block diagrams to determine a troubleshooting procedure for a fault.
13. Describe instruments and procedures for testing the proper functioning of control systems:
    a) electrical testers
    b) pressure testers
    c) code readers
    d) loading devices or equipment testers
    e) function testing controllers and equipment.

SECTION TWO ..... POWERED EQUIPMENT ..... 114 HOURS

A. Cutting Equipment ..... 18 Hours

Outcome: ***Set up and maintain cutting equipment.***

1. Maintain and sharpen saw chains and bars.
2. Maintain and sharpen rotary mower blades.
3. Maintain and sharpen reel cutters.
4. Set up turf mowing equipment for cutting requirements.

B. Pumps and High Pressure Washers ..... 9 Hours

Outcome: ***Service pumps.***

1. Describe classes of pumps their functions and limitations:
    a) water
    b) trash
    c) sewage
    d) dewatering
    e) high pressure
    f) pressure washers.
2. Describe the effect of location, height, intake and output length on pumping ability.
3. Assess condition of seals, housing and impellers.
4. Remove and replace pump seals.
5. Remove and replace pump housing and impellers.
6. Inspect and service pressure washer pumps and components.
7. Function test pumps and pressure washers to verify output meets OEM specifications.

C. Generators ..... 18 Hours

Outcome: ***Service single phase and three phase portable generators.***

1. Describe mobile AC generator operation.
2. Describe portable light tower lights and lighting system.
    a) metal halide lights
    b) transformers
    c) capacitors

3. Describe motorized welders and welding current.
4. Set generator output for voltage, phase, and frequency according to customer requirements.
5. Calibrate welder output to specifications.
6. Test generator output using instruments and load banks.
7. Test welder welding current output.
8. Troubleshoot controls, windings, and regulators to determine location of faults.
9. Troubleshoot welders:
   a) brush type
   b) brushless.
10. Troubleshoot light tower lighting system and components.
11. Determine corrective action for faults.

D. Air Compressors and Air Dryers ..... 12 Hours

Outcome: ***Maintain air compressors.***

1. Describe screw vs. reciprocating air compressors.
2. Describe requirements for controlling oil and moisture content of compressed air.
3. Describe oil less air compressors.
4. Describe the operation of air dryers.
5. Adjust and service pressure regulators.
6. Describe typical air compressor maintenance requirements and schedule.
7. Service air dryers.
8. Troubleshoot faulty air compressor operation.
9. Determine and apply corrective actions for problems.

E. Portable Heaters ..... 6 Hours

Outcome: ***Maintain portable heater systems.***

1. Describe the operation of oil fired heaters.
2. Describe the effect extreme cold temperature has on portable heater fuels and how to compensate for extreme cold.
3. Perform routine inspections and maintenance on oil fired heaters.
4. Describe operation of LPG and natural gas fired portable heaters.
5. Troubleshoot malfunctioning portable heaters and determine corrective action.

F. Golf Carts and Utility Vehicles ..... 15 Hours

Outcome: ***Maintain golf and utility vehicles.***

1. Describe deep cycle battery charging systems.
2. Describe deep cycle battery servicing.
3. Test deep cycle battery condition.
4. Describe fleet battery charging systems.
5. Test charging system output.
6. Describe fleet rotation and cart barn set up.

7. Describe engine reverse systems.
8. Describe generator starters.

G. Lifting Equipment ..... 30 Hours

Outcome: ***Diagnose and repair lifting equipment according to legislative, industry and OEM requirements.***

1. Describe training requirements for operating lifting equipment.
2. Describe regulatory requirements and regulatory agencies for inspections of mobile lifting equipment.
3. Describe regulatory requirements for repairing damaged lifting equipment components.
4. Describe procedures for safe handling and repair of heavy components.
5. Describe function testing of all lifting equipment controls, limit switches, speed switches.
6. Describe function testing of outriggers, pot hole protection, and level controls.
7. Describe the inspection of lifting equipment and determining corrective action if required.
8. Describe the removal, replacement or repair of lifting equipment components in accordance with legislative and OEM requirements.

H. Excavation and Levelling Equipment ..... 6 Hours

Outcome: ***Diagnose and repair excavation and levelling equipment.***

1. Describe the inspecting excavation buckets and blades for wear and damage and applying the appropriate corrective action.
2. Describe the inspection of trenchers for wear and damage and required corrective action.
3. Describe the devices used for tamping and levelling and how they work.
4. Describe the service of tampers, rollers, etc., and their components.

FINAL PERIOD RECREATIONAL EQUIPMENT TECHNICAL TRAINING
OUTDOOR POWER EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE..... RECREATIONAL EQUIPMENT FUEL SYSTEMS ..... 30 HOURS

A. Recreational Equipment Carburetor Identification ..... 2 Hours

Outcome: Describe carburetors for marine and off road recreational equipment.

1. Describe typical ATV marine and snowmobile carburetors.
2. Describe constant velocity (CV) carburetors.
3. Compare CV carburetor operation to conventional slide carburetor operation.
4. Describe the following carburetor types:
   a) Rochester and Holley two barrel
   b) Rochester, Weber and Holley four barrel.
5. Describe outboard proprietary butterfly carburetors.

B. Carburetor Troubleshooting ..... 10 Hours

Outcome: Adjust and troubleshoot marine and recreational equipment carburetors.

1. Describe how carburetor faults are isolated.
2. Describe how a carburetor fault is determined and the steps required to solve the problem.
3. Adjust and troubleshoot:
   a) Holley and Rochester two barrel
   b) Holley Rochester and Weber four barrel
   c) Mikuni round slide, flat slide, CV, butterfly Super BM
   d) Keihin round slide, flat side, CV, butterfly
   e) Proprietary outboard butterfly.
4. Synchronize multiple carburetors using various techniques.

C. Jetting Principles ..... 3 Hours

Outcome: Perform jetting modifications on marine and recreational equipment carburetors.

1. Describe why jetting modifications are made.
2. Describe the procedure for making and evaluating changes to jetting.
3. Describe initial carburetor set up:
   a) new OEM replacement or rebuilt or serviced carburetor set up
   b) non OEM replacement type set up
   c) new OEM different carburetor type set up.

4. Describe how to evaluate initial settings and make adjustments for optimal performance:
   a) piston wash
   b) plug reading.
5. Describe function and installation of a pyrometer.
6. Describe how to use pyrometer readings to evaluate jetting.
7. Describe Dial A Jet / Power Jet function and installation.
8. Describe altitude compensators and DPM.
9. Troubleshoot altitude compensator and DPM.

D. Direct Injection ..... 15 Hours

Outcome: ***Service direct injection systems.***

1. Describe and identify and describe the following injection system types:
   a) Ficht
   b) Orbitol
   c) HPDI.
2. Describe components of Direct Injection (DI) systems used in recreational equipment:
   a) lift pumps
   b) vapour separators
   c) high pressure pumps
   d) regulators
   e) battery-less fuel injection systems.
3. Test and troubleshoot direct injection systems:
   a) marine DI
   b) off road DI.

SECTION TWO ..... RECREATIONAL EQUIPMENT TRANSMISSIONS ..... 70 HOURS

A. Transmissions ..... 20 Hours

Outcome: ***Service outdoor power equipment transmissions.***

1. Define gear terminology.
2. Identify the gear types found in power equipment and describe their applications.
3. Describe planetary transmissions and their application in marine drives systems.
4. Identify gear tooth types and applications.
5. Describe gear tooth contact patterns.
6. Describe shift mechanisms:
   a) synchromesh and non synchromesh
   b) constant mesh.

7. Describe shift selection types:
   a) linear
   b) non linear
   c) selector forks
   d) rotary selection
   e) gear dogs.
8. Disassemble inspect and re-assemble a basic transmission.

B. Centrifugal Clutches ..... 20 Hours

Outcome: ***Service centrifugal clutches.***

1. Describe relationship between clutch adjustment, horsepower and torque.
2. Describe centrifugal clutch parts and function.
3. Adjust or alter clutch components to optimize performance.
4. Perform clutch alignments:
   a) center to center
   b) alignment or skew
   c) offset
   d) belt deflection.
5. Describe drive belt selection.
6. Perform drive belt failure analysis.

C. Multi Plate Clutches. ..... 10 Hours

Outcome: ***Service multi plate clutches.***

1. Describe the construction of a typical multi plate clutch.
2. Diagnose multi plate clutch problems.
3. Adjust a multi plate clutch assembly.
4. Disassemble inspect, and re-assemble a multi plate clutch.

D. Marine Drive Shimming ..... 20 Hours

Outcome: ***Perform marine shimming.***

1. Describe marine shimming procedures:
   a) pinion height
   b) forward gear lash
   c) reverse gear lash
   d) end float.
2. Perform marine shimming procedure on various gear housings.

SECTION THREE: .....RECREATIONAL ENGINE OVERHAULS ..... 60 HOURS

A. Engine Repair Estimates ..... 1 Hour

Outcome: ***Prepare time and parts estimates for engine repair or rebuild.***

1. Prepare estimates of parts, labour and sublet repairs, where applicable, prepare repair options for customer.

B. Measurement and Inspection ..... 17 Hours

Outcome: ***Use precision measuring tools to inspect and evaluate internal engine wear/condition.***

1. Disassemble engine, inspect and measure the following components to factory wear specifications:
   a) cylinder
   b) crank shaft
   c) piston
   d) rings
   e) head and valve train
   f) connecting rod
   g) bearings.

C. Recondition Parts ..... 12 Hours

Outcome: ***Recondition serviceable engine components.***

1. Describe the purpose of factory specified operating clearances for the following components:
   a) cylinders
   b) crankshaft
   c) pistons and ring
   d) heads and valve train
   e) connecting rod
   f) bearings.
2. Describe how engine design and purpose effects specified clearances.
3. Describe total allowable wear limits.
4. Describe economic considerations for replacing worn components with new parts, reconditioned parts, reconditioning the parts in the shop, or replacement with a new unit.
5. Perform the following reconditioning procedures for applicable engine type where the procedure is appropriate:
   a) hone cylinder
   b) check and adjust piston ring end gap
   c) grind and lap valve.

D. Reassembly of Engines ..... 27 Hours

Outcome: ***Assemble two stroke and four stroke, marine and off road engines according to specifications.***

1. Re-assemble engine.
2. Describe why cleanliness is essential for reassembly.
3. Fit pistons and rings, hone cylinders.
4. Describe the purpose of assembly clearance and why clearances might vary for different engine types or manufacturers.
5. Assemble crankshaft and connecting rods, check for proper clearance and fit.
6. Install insert bearing bottom end type.
7. Inspect new roller bearing bottom end for fit and clearance.
8. Assemble valves springs and spring keepers, assemble valve train.

9. Replace -reassemble gaskets, seals and O-rings.
10. Perform final assembly of engine and related components, lubricants and coolants initial adjustments, as required.

E. Testing of Rebuilt Engine and Final Adjustments ..... 3 Hours

Outcome: Perform an initial running in and evaluation of a reconditioned engine.

1. Do an inspection and start up of newly assembled engine.
2. Perform running adjustments, synchronization.
3. Test and evaluate the newly assembled engine under operating conditions or an adequate simulation.

SECTION FOUR: ..... MARINE RECREATIONAL EQUIPMENT ..... 40 HOURS

A. Marine Fuel Supply Systems ..... 1 Hour

Outcome: Describe the fuel systems for marine equipment.

1. Describe safety issues for marine fuel systems.
2. Describe bilge venting systems.
3. Describe anti siphon valves.
4. Describe marine fuel supply systems.
5. Describe marine fuel pumps.
6. Test marine fuel supply operation:
   a) vacuum
   b) pressure
   c) air leak test.

B. Shifting ..... 2 Hours

Outcome: Service marine transmissions and clutches.

1. Describe various marine shift mechanisms:
   a) electric shift
   b) mechanical shift
   c) cone clutch
   d) adjust shift mechanisms.

C. Transom Plates ..... 3 Hours

Outcome: Service transom plates.

1. Describe transom plate service procedures:
   a) alignment
   b) drive installation.

D. Jet Drives.....10 Hours

Outcome: ***Describe jet drive systems.***

1. Describe pump types:
   a) mixed flow
   b) axial flow
   c) outboard pumps.
2. Describe jet drive components:
   a) intake grate
   b) impeller
   c) wear ring
   d) stator
   e) nozzle.
3. Perform maintenance and adjustment:
   a) impeller clearance
   b) shift mechanism
   c) bearings
   d) alignment
   e) troubleshooting.
4. Describe jet drive performance accessories:
   a) grates
   b) impellers
   c) trim.
5. Install and troubleshoot jet drive performance accessories.

E. Power Trim .....18 Hours

Outcome: ***Service power trim systems.***

1. Describe trim limit methods.
2. Troubleshoot trim limit.
3. Describe power trim components used by various manufacturers.
4. Describe marine power trim operation.
5. Test and troubleshoot Marine power trim systems.

F. Props and Hulls .....5 Hours

Outcome: ***Troubleshoot propeller and hull performance.***

1. Describe prop characteristics and operation:
   a) pitch
   b) diameter
   c) rake
   d) cupping
   e) slip.

2. Describe materials used for props:
   a) aluminum
   b) steel
   c) brass/bronze
   d) composite.
3. Describe prop design:
   a) number of blades
   b) blade shape
   c) blade size
   d) hub type.
4. Describe prop troubleshooting:
   a) cavitation
   b) ventilation
   c) slip calculation
   d) speed calculation.
5. Describe hull design and terminology:
   a) transom angles
   b) bottom configuration
   c) materials.
6. Describe handling problems:
   a) hull defects
   b) engine height
   c) torque problems
   d) speed loss.

G. Marine Accessories ..... 1 Hour

Outcome: ***Describe accessories for marine equipment.***

1. Describe marine electronic accessories.
   a) depth and fishfinders
   b) radios
   c) alternator output
2. Describe the use of a pyrometer in monitoring engine efficiency and performance:
   a) types
   b) installation
   c) location
   d) effect on temperature with location.
3. Describe hull accessories and their installation:
   a) set back plates
   b) transom jacks
   c) downriggers
   d) trim tabs
   e) ski bars
   f) swim platform / ladders
   g) steering and control systems
   h) other.

4. Describe trailer accessories:
   a) electric winches.

SECTION FIVE.....OFF ROAD RECREATIONAL EQUIPMENT ..... 40 HOURS

A. Track Drives .....10 Hours

Outcome: ***Select and service snowmobile drive tracks.***

1. Describe snowmobile track types and sizes.
2. Perform track service and maintenance:
   a) alignment
   b) tension
   c) clip replacement.
3. Troubleshoot tracks and components.
4. Describe track selection for specific applications.
5. Describe accessory or replacement track types and modifications:
   a) types and profiles
   b) pitch and driver styles
   c) traction aids
   d) stud types
   e) cleats and claws
   f) installation and clearances.
6. Describe the relationship between chaincase ratio driver size, and track configuration:
   a) gear ratios
   b) drivers
   c) track clearance
   d) angle of attack.
7. Remove and replace drive shaft.
8. Remove, replace and recondition chain case.

B. Steering .....5 Hours

Outcome: ***Service snowmobile and recreational equipment steering systems.***

1. Describe recreational vehicle suspension systems:
   a) steering angles
   b) caster
   c) camber
   d) scrub
   e) bump steer
   f) skid steered ATVs
   g) alignment procedures.
2. Perform steering alignment.
3. Describe skis, ski types and wear rods.

C. Shocks ..... 4 Hours

Outcome: ***Describe servicing and rebuilding shock absorbers.***

1. Perform shock absorber service:
   a) rebuild shock
   b) re-valve shock.

D. ATV and Snowmobile Suspensions ..... 11 Hours

Outcome: ***Describe off road suspension service and adjustment.***

1. Describe recreational front suspension:
   a) leaf spring
   b) A arm
   c) ball joints
   d) trailing arm
   e) telescopic strut
   f) torsion and sway bars.
2. Describe recreational rear suspension:
   a) slider
   b) bogie
   c) linked or coupled
   d) rising / progressive rate.
3. Describe torque reaction and weight transfer.
4. Perform front and rear suspension adjustments:
   a) weight transfer rods / stops
   b) ride height
   c) spring preload
   d) sway bars.

E. Accessories ..... 10 Hours

Outcome: ***Install engine accessories, modify engine performance.***

1. Describe typical dealer installed electrical accessories:
   a) wiring procedures
   b) battery systems
   c) heated grips
   d) lights and horns
   e) electric winches.
2. Describe engine accessories:
   a) reeds
   b) lightened components, flywheel etc.
   c) air intake components
   d) turbocharger / supercharger
   e) other.
3. Describe performance enhancing exhaust systems.

4. Describe the two-stroke performance enhancing exhaust system:
   a) tuned pipe
   b) expansion chamber
   c) stingers
   d) expansion chamber mufflers
   e) effects of pipe temperature.
   f) four stroke pipe tuning
   g) effect of length on power at specific engine rpm
   h) one into one tuned pipe systems
   i) multi cylinder tuned pipe configurations
   j) mufflers and spark arrestors.
5. Describe EFI and DI performance modification and performance modules.
6. Describe trailers and truck decks for off road recreational equipment.

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